



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/697,137	10/30/2003	Jeffrey A. West	TI-36238	9756

23494 7590 09/30/2004

TEXAS INSTRUMENTS INCORPORATED
P O BOX 655474, M/S 3999
DALLAS, TX 75265

EXAMINER

GUERRERO, MARIA F

ART UNIT PAPER NUMBER

2822

DATE MAILED: 09/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

120

Office Action Summary

Application No.

10/697,137

Applicant(s)

WEST ET AL.

Examiner

Maria Guerrero

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. This Office Action is the First Office Action on the merits.

Status of Claims

2. Claims 1-12 are pending.

Specification

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Information Disclosure Statement

4. The information disclosure statement filed October 30, 2003 has been considered.

Claim Objections

5. Claim 12 is objected to because of the following informalities: claim 12 recites: "transferring to semiconductor body to a chamber". Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 7-12 are rejected under 35 U.S.C. 102(b) as being anticipated by Filipiak et al. (U.S. 5,447,887).

7. Filipiak et al. shows providing a semiconductor body having a trench formed in a dielectric layer at a surface thereof (Fig. 2, col. 2, lines 50-65, col. 3, lines 10-35).

Filipiak et al. teaches forming a copper film over the semiconductor body including the trench (Fig. 3, col. 3, lines 40-50). Filipiak et al. discloses chemically-mechanically polishing the copper film to form a copper interconnect and doping the copper interconnect with silicon (Fig. 4-5, Abstract, col. 4, lines 1-55). Filipiak et al. shows flowing silane over a surface of the copper interconnect for approximately 3 seconds and at a temperature of 200°C to 450°C (col. 4, lines 44-55, col. 5, lines 10-20).

8. Furthermore, Filipiak et al. discloses the doping being part of a silicon nitride deposition process (col. 4, lines 28-68, col. 6, lines 25-40). Filipiak et al. teaches transferring the semiconductor body to a chamber, performing the doping by flowing silane for a given time prior striking a plasma in the chamber (Fig. 1, Abstract, col. 2, lines 24-28). Filipiak et al. shows striking the plasma after flowing the silane for about 3 seconds (at least 0.5 seconds is included) and flowing at least one nitrogen-containing

source gas into the chamber to deposit a silicon nitride layer over the copper interconnect (Fig.1, Abstract, col. 2, lines 24-32, col. 5, lines 10-20, col. 6, lines 25-45).

9. Claims 1-2 and 4-11 are rejected under 35 U.S.C. 102(b) as being anticipated by Ngo et al. (U.S. 6,211,084).

Ngo et al. teaches forming a dielectric layer, forming openings in the dielectric layer, filling the openings with a barrier, a copper seed and an electroplated copper film (Fig. 1-2, Abstract, col. 5, lines 60-67, col. 6, lines 1-5). Ngo et al. shows chemically-mechanically polishing the copper film and gaseously doping the copper film with silicon (Fig. 1-2, Abstract, col. 6, lines 1-12). Ngo et al. discloses the dielectric layer comprising an interlevel dielectric having vias and an intrametal dielectric having trenches (Fig. 1-2, col. 1, lines 35-65, col. 5, lines 60-67). Ngo et al. teaches doping only a top region of the copper film with silicon by flowing silane at a temperature of about 250°C to about 350°C for about 1 to about 10 seconds (Fig. 2-3, col. 5, lines 50-60). Ngo et al. shows the doping as part of a silicon nitride deposition process (Fig. 3-4, Abstract, col. 4, lines 48-55, col. 6, lines 10-12).

In addition, Ngo et al. teaches providing a semiconductor body having a trench formed in a dielectric layer at a surface thereof (Fig. 1-2, col. 1, lines 35-65, col. 5, lines 60-67). Ngo et al. discloses forming a copper film over the semiconductor body including the trench (Fig. 1-2, col. 5, lines 60-67). Ngo et al. shows chemically-mechanically polishing the copper film to form a copper interconnect and doping the copper interconnect with silicon (Fig. 1-4, col. 6, lines 1-12).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. (U.S. 6,211,084).

11. Regarding claim 3, Ngo et al. does not specifically show the final bulk silicon concentration in the range as claimed. However, Ngo et al. the reaction between copper and silicon forming Cu_xSi_y , wherein $y=1$ and $x=3-5$ (col. 6, lines 18-20).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to specify the range as claimed by routine experimentation because there is not evidence of criticality. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). See MPEP § 716.02 - § 716.02(g).

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Havemann et al. (U.S. 6,358,849), Gross et al. (U.S. 6,297,154), Shue (U.S. 6,281,127), Van Ngo et al. (U.S. 6,153,523), Jain (U.S. 5,821,168), Ngo et

al. (U.S. 6,146,988), Aoki et al. (U.S. 6,787,480), Huang et al. (U.S. 6,355,571), Ruelke et al. (U.S. 6,569,768), Gupta et al. (U.S. 6,274,499), and Ngo et al. (U.S. 6,432,822) show several embodiments related to applicant's disclosure.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maria Guerrero whose telephone number is 571-272-1837.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 571-272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

September 27, 2004

Maria Guerrero
MARIA F. GUERRERO
PRIMARY EXAMINER